The Lakeshore Guardian, 2010 September
Thumb Habitats
Aquatic Macroinvertebrates
by Bill Collins

On land, September is a time of seed and dry in Michigan. It is also a time when newly hatched water babies begin their underwater lives, spending the on-coming fall and long winter feeding and growing down in the wetlands, creeks, rivers, ponds, and lakes around us. These are the aquatic macroinvertebrates, or in other words, water creatures visible without a microscope and lacking internal skeletons and backbones. Not fish, frogs, or turtles, but insects, worms, leeches, crustaceans (crayfish, shrimp, scuds, sowbugs), snails, and mussels. “Macroinvertebrate” is just a convenient way to distinguish these creatures from mostly larger vertebrates and smaller microscopic animals.

Photos top to bottom: left side: mayfly nymph, caddisfly larva, stonefly nymph, damselfly nymph, middle: alderfly larva, dobsonfly larva, dragonfly nymph, right side: midge larva, water boatman adult, water penny larva, scud adult. Photographs compliments of Troutnut.com and Jason Neuswanger.

Macroinvertebrates are near the base of the aquatic food chain, only a step or two above the plants that most eat. They are the primary food of many fish, amphibians, and some waterfowl, and their abundance determines, in large part, the wildlife that thrives in our waters. Those who spend time near the water are quite familiar with larger macroinvertebrates like mussels, or clams, snails, crayfish, and leeches. Insects tend to be the most abundant but lesser known macroinvertebrates in freshwater ecosystems. They exist first as eggs, then larvae or nymphs, then pupae, and finally adults. Many adult insects briefly leave the water on new wings to mate and start the process over again. Fly fishers have an intimate knowledge of the insects inhabiting the cool, clean streams they fish, supporting the trout they love to catch. They take great care in tying artificial flies to mimic the mayflies, caddisflies, stoneflies, alderflies, dobsonflies, midge flies, damselflies, and dragonflies.

I remember huge mayfly hatches in Port Huron in the 1970s. Mayflies mistake pavement for water, tragically depositing their eggs on roads and parking lots.

Yellow Mayfly. Photograph by Michael Palmer, CC BY-SA 4.0, via Wikimedia Commons

As kids, we caught caddisflies in a swamp near our house. They look like an aquatic caterpillar encased in a tube of wood and leaf fragments, pebbles, or mud.

Casemaker caddisfly larva encased in small stems, clam shells, and other materials held together by a silk-like substance. This is just like those we found as kids in the Thumb Land Conservancy Dead End Woods Sanctuary.

Pycnopsyche species caddisfly adult at South Point Island in Killarney, Ontario, Canada. Photograph by Ryan Hodnett.

Most have seen damselflies fluttering gracefully on black wings over a creek or wetland, and their cousins the dragonflies, the clear-winged aerial speed demons. They have not sewn my eyes shut or bit me yet.

Beautiful Demoiselle (*Calopteryx virgo*) male damselfly, Crockford Stream, Hampshire. Photograph by Charles J. Sharp from Sharp Photography, sharpphotography.co.uk.

Water scorpion *Ranatra linearis*, Desniansko-Starogutskyi National Park, Ukraine, 2018. Ihor Panas.

Other aquatic insects include the “true bugs” in the order Hemiptera. Most are predatory and include waterboatmen that look like beetles with two oars, backswimmers that look like waterboatmen but swim upside-down, water striders that look like spiders gliding across the water, and water scorpions that look like stick bugs and are not really scorpions. Aquatic beetles are mostly predatory and include riffle beetles that crawl along stony stream beds, water-penny beetles that are round and nearly flat, whirligig beetles that swirl about on the surface, and diving beetles with a nasty bite, often found in swimming pools.

Whirligig beetles *Gyrinus* species. Fort Custer Recreation Area, Michigan. Jacob Enos.

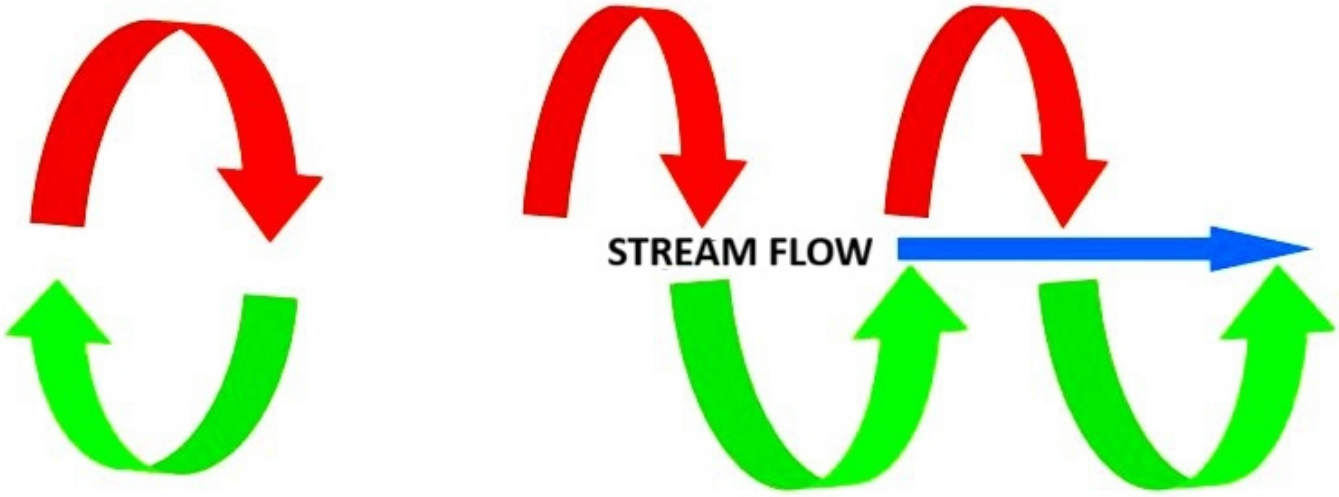
Slow season insects hatch, feed, and grow as larvae or nymphs through the fall and winter. Pupae and adults then emerge in spring and early summer. These include mayflies, stoneflies and dobsonflies, which remain in the water for years before emerging. Fast season insects, like caddisflies, remain as eggs from summer through the next spring. The larvae or nymphs emerge in spring, and become adults in summer. Mosquitoes complete this cycle in just a few weeks.

Aquatic macroinvertebrates are divided into four general functional groups: shredders, grazers, collectors, and predators. Shredders feed on large organic material that falls into the water, especially tree leaves, and include mayflies and stoneflies. Grazers scrape and eat periphyton (basically algae) off objects in the water and include snails, beetles, and caddisflies. As shredders and grazers feed and defecate, they release smaller particles that drift downstream. Collectors feed upon this particulate by filtering it from the water, and include blackflies, nematodes and mussels. Predators may feed on plant material, but mostly eat the shredders, grazers, collectors, other predators, and even small fish and amphibians. Predators include dragonflies, dobsonflies, the hemipterans, water beetles, and sometimes crayfish.

Dragonfly nymph (large) with mayfly nymphs (3-parted tails) and beetle nymph (upper right). Obsessed By Nature: https://www.obsessedbynature.com/blog/tag/dragonfly-larva/

There are usually a lot of shredders and collectors in the headwaters of a river because of the large amount of leaves entering the water. Their numbers tend to increase in the fall. Grazers increase in the mid-reaches of the river where algae increases with more sunlight and nutrients. Collectors increase in the lower reaches with the abundance of fine organic particles drifting down from the upper river. The proportion of predators remains fairly constant throughout rivers as they do not depend on organic matter size, just other organisms.

I had a stream ecology course at Michigan State University in the mid-1980s and was introduced to the very interesting concept of nutrient spiraling in streams, even as details of the concept were still being developed. The idea is that as nutrients are carried downstream, they are also circulated between the water, sediment, and aquatic plants. Some nutrients pass up the food chain to fish, or leave the stream entirely in a bird, but most is cycled around and around with the help of aquatic macroinvertebrates. This simplified pathway of nutrient circulation with downstream movement can be represented together by a spiral, or a helix, like a spring stretched out from the headwaters to the river mouth.



Nutrient cycling (left) as compared to nutrient spiraling (right). Nutrients cycle in a relatively stationary ecosystem like a small forest or isolated wetland, moving primarily from plants to ground back to plants. Nutrients spiral in flowing ecosystems like streams, moving primarily from plants to macroinvertebrates and vertebrates (like fish) back to plants, but the whole cycle moving downstream at the same time.

Some macroinvertebrates are very sensitive to water conditions like temperature, dissolved oxygen, flow, sediment, substrate, nutrients, and pollution. Their presence and abundance are reliable indicators of water quality and will be explained in the next article.

Freshwater mussels on a stream bed.